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Effect of the Addition of Blueberries on Selected Physicochemical and Sensory Properties of Yoghurts

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Summary

In this research, physicochemical and sensory properties of blueberries and sugar added to yoghurts have been investigated on the first, 10th and 20th day of storage in refrigerator. Samples were analyzed for pH, total solids, protein, fat, ash, viscosity, syneresis, Hunter's *L*, *a*, and *b* values, flavour, body, texture, appearance and colour. Blueberry and sugar mass fractions and storage time had a significant effect on the physicochemical and sensory properties of yoghurts. The addition of blueberries to yoghurt formula resulted in an increase in the syneresis and a decrease in the pH, fat, protein, ash, viscosity and whiteness values. The addition of sugar improved only the flavour of yoghurts. Panelists favoured samples with 25 % blueberries and 4 % sugar in terms of flavour, body, texture, appearance and colour.

Key words: blueberry, sugar, yoghurt, syneresis, storage time

Introduction

Several studies have demonstrated that blueberries have anticarcinogenic, antidiabetic, antimutagenic, and antimicrobial properties and can reduce eye strain, improve circulation, protect against gastric ulcers and cardiovascular disease, and reverse brain and behavioural changes related to aging (*1–5*). Schmidt *et al.* (*6*) found that blueberry proanthocyanidins inhibited the growth of prostate cancer cells. Rats treated with blueberry, spinach, or Spirulina had significantly lower neurodegenerative disorders (*7*). Polyphenols from both blueberry and cranberry protected microvascular endothelial cells against oxidative and inflammatory insults (*8*). Blueberry supplementation was also recommended to athletes exercising in hot environments due to reduction of exercise-induced oxidative stress (*9*).

Yoghurt and related products continue to increase in popularity in many countries around the world. Consumers, especially children, demand novel yoghurt formulations more than traditional ones like plain yoghurt. These are non-fat yoghurt, whipped yoghurt, yoghurt smoothies, organic yoghurt, and minimally processed fruit yoghurts (*10*). Introduction of various fruit-flavoured yoghurts has significantly contributed to the consumption of yoghurt from all ages. Fruits may be added to yoghurt formulae as single or blends in the form of refrigerated, frozen, canned fruit, juice or syrup. Most common fruits used in yoghurt formulae are peach, cherry, orange, lemons, purple plum, boysenberry, spiced apple, apricot, pineapple, strawberry, raspberry and blueberry (*11*). Incorporation of fruits endorses the healthy image of yoghurts. In contrast to the study dealing with the health influences of the addition of fruit, there is a very limited research about the technological, physicochemical, organoleptic, and microbiological properties of fruit-added yoghurts. Bardale *et al.* (*12*) prepared a shrikhand-like product from skim milk known as chakka by fortifying it with the apple, papaya and mango fruit pulp at 0, 10, 20, 30, and 40 % levels. Chemical and organoleptic evaluation revealed that it is essential to obtain quality product by blending in 20 % fruit pulp. Barnes *et al.* (*13*) stated that fruit-flavoured yoghurts require an appropriate balance of sweetness

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and sourness, and therefore sufficient flavour intensity should be involved in the flavoured yoghurts to mask the plain yoghurt base. The pH of fruit-added yoghurts increased from 4.2 to 4.4 during 30 days of storage (*14*). The nectar of soursop (*Annona muricata* L.), a highly aromatic tropical fruit with white juicy flesh, was incorporated into the stirred yoghurt formula at concentrations of 0, 5, 10 and 15 % and panelists gave the highest scores to the yoghurts with 10 and 15 % of soursop nectar (*15*). Cornelian cherry pastes at 5 and 10 % were added to the yoghurt formula with 10 and 15 % of sugar, and yoghurts with 10 % fruit paste and 10 % sugar were found to be more acceptable compared to the other yoghurts (*16*).

The effect of the addition of blueberries on the technological, physicochemical and organoleptic properties of yoghurts has not been studied in the literature. Therefore, the main objective of this research is to study the effects of blueberry addition on the compositional, physicochemical and organoleptic properties of yoghurts.

Materials and Methods

Materials

Cow's milk was obtained from Samyo Dairy Company (Samsun, Turkey). The yoghurt culture including *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* was obtained from Rhodia Food (France). Highbush blueberry cultivars were obtained from Agricultural Research Center (Rize, Turkey). Experimental yoghurts were made in the Pilot Plant of Food Engineering Department, Faculty of Engineering, Ondokuz Mayis University, Turkey.

Yoghurt manufacture

Fresh milk was pasteurized at 85 °C for 10 min using a plate heat exchanger (Kromel, Turkey). The pasteurized milk was pumped into the balance tank of the two-stage falling film evaporator and condensed to a final mass fraction of approx. 14 % (75 °C, 80 kPa). The concentrated milk at 42 °C was inoculated with freeze-dried yoghurt culture at 2.5 % inoculation level. The inoculated milk was immediately transferred to yoghurt containers and incubated at 42 °C until the pH decreased to 4.8 (about 3 h required). The yoghurt samples were cooled to 25 °C by resting in a temperature controlled room (15 °C) and then stored at 3–5 °C for a period of 12 h. Based on total mass, 0, 12.5, 25 and 37.5 % of blueberry pulp (blueberries were first cleaned, then chopped with a blender for 60 s, filtered from small seeds, heat treated at 85 °C for 15 min, and filled into the sterile jars) and 0, 2, 4 and 6 % of sucrose (heated in a sterile glass jar at 75 °C for 30 min) were added to the appropriate amount of yoghurts. The yoghurts with added blueberry were transferred to sterile plastic containers with lids and stored at 3–5 °C for 20 days. Two independent trials of yoghurts were made and three replicate yoghurt samples were analyzed on the 1st, 10th, and 20th day.

Physicochemical analysis

The pH of the samples was measured with an inoLab pH meter (inoLab, Weilheim, Germany). Total solids, protein, fat, ash, and potentiometric acidity were determined according to the methods described by Bradley *et al*. (*17*) and AOAC (*18*).

Viscosity

Viscosity measurements were taken at 4 °C with a Brookfield viscometer (Model DV-1+; Brookfield Engineering Laboratories, Inc., MA, USA) after blending yoghurts in 250-mL containers. The viscometer was operated at 20 rpm (spindle number 4). Each result was recorded in Pa·s after a 30-second rotation. The average value of 10 measurements was taken.

Syneresis

Syneresis was measured by the method of Modler *et al*. (*19*). A mass of 25 g of yogurts was weighed onto a wire mesh screen placed over a funnel in a graduated cylinder. Samples were placed in a refrigerator at 6 °C immediately after weighing. Syneresis (mL/100 g) was expressed as the volume of exudate collected after 2 h of refrigeration.

Colour

A colourimeter (Minolta Chroma Meter CR-300, Japan) was used to determine whiteness (L), red/greenness (a), and yellow/blueness (b) values of the yoghurts with added blueberry. A white tile (No. 21733001) was used to standardize the instrument. The average value of 10 measurements was taken.

Sensory analysis

A number of 10 to 15 trained panelists selected from University staff members who consume yoghurts with fruit in large amounts in their diets and had previous taste panel experience rated the sensory properties of the yoghurt samples. Initially, panelists were trained in 2-hour sessions prior to evaluation to be familiar with the attributes and scaling procedures of the samples. Yoghurt samples were organoleptically examined according to the method modified from Ogden (*20*) with maximum scores of 10, 5 and 5 for flavour, body and texture, and appearance and colour, respectively, the highest number indicating liking extremely and the lowest disliking extremely. The panelists were also asked to note any acetaldehyde, bitter, foreign, acid (too high or too low), oxidized, unnatural flavour, fruit flavour (too high or too low), sweet taste (too high or too low) and other perceived attributes for flavour; and gel-like, grainy, ropy, too firm, too weak, and other perceived attributes for body and texture; and wheyed-off, lumpy, shrunken, atypical colour, colour leaching, too dark colour, and other perceived attributes for appearance and colour. The yoghurt samples in 100-mL yoghurt cups were coded with three-digit random numbers and presented to the panelists. Orders of serving were completely randomized. The panelists were instructed to cleanse their palate with plain crackers and water before tasting each sample. The evaluations were done after 1, 10 and 20 days of storage at 4–6 °C.

Statistical analysis

Statistical analysis of data for the effects of factors on pH, total solids, protein, fat, ash, viscosity, syneresis, colour, and sensory properties was performed by randomized complete block design with two and three factors (*21*). The factors were: (*i*) mass fraction of fruit (0, 12.5, 25 and 37.5 %), (*ii*) sugar mass fraction (0, 2, 4 and 6 %), and (*iii*) storage time (first, 10th, and 20th day). The mean differences were analyzed using Duncan's multiple-range test at $p<0.05$.

Results and Discussion

Compositional analysis

The evaporated milk used for the yoghurt production had pH=6.67, 0.18 % titratable acidity, 15.24 % total solids, 4.95 % protein, 3.9 % fat, and 0.97 % ash. The blueberry pulp blended with the yoghurts had pH=3.41, 0.64 % potentiometric acidity, 15.50 % total solids, and 0.16 % ash.

Table 1 shows the chemical properties of yoghurts. Fruit addition did not affect significantly the mass fraction of total solids in the yoghurts ($p>0.05$). This result was expected because the mass fraction of total solids in the fruit used for the yoghurt production is very close to those of the milk used for the yoghurt production. The mean mass fraction of total solids in our study was 17.67, and this value is similar to that found in yoghurts with added raspberry (*22*) and lower than that found in yoghurts with tropical fruit (*23*). Sugar addition at all levels significantly increased the mass fraction of total solids in the yogurts. The yoghurts without sugar had the least total solids, while the highest total solids were in yoghurts with the addition of 6 % of sugar.

Increasing the mass fraction of blueberries significantly reduced the mass fraction of fat in the yoghurts ($p<0.05$). The highest mass fraction of fat of 3.9 % was obtained in the samples without blueberry and sugar, while the lowest (1.7 %) in the samples with 37.5 % of fruit. The mean mass fraction of fat in the yoghurts with blueberries and sugar was similar to those found by Davis and McLachlan (*24*) and Souza (*25*), and generally lower than those reported in the literature (*26–28*). Sugar addition significantly reduced the mass fraction of fat in the yoghurt samples ($p<0.05$), but there was no significant difference between 4 and 6 % levels.

The mass fraction of protein in yoghurts with added fruit was significantly lower than of the yoghurts without fruit ($p<0.05$). The samples with 37.5 % fruit and 6 % sugar contained the least mass fraction of protein (3.03 %), while the yoghurts without fruit and sugar had the highest protein mass fraction of 5.19 %. The average mass fraction of protein in the control and yoghurts with fruit is similar to those obtained from yoghurts with different fruit in the literature. The mass fraction of protein in yoghurts did not decrease significantly as the sugar mass fraction increased ($p<0.05$), but control yoghurts (without sugar) had significantly higher protein mass fraction than the yoghurts with added sugar ($p<0.05$).

As the mass fraction of blueberries increased, the ash mass fraction significantly decreased ($p<0.05$). It was reduced from 0.99 % in control samples to 0.67 % in the samples with 37.5 % fruit without sugar. The effect of sugar mass fraction on the ash mass fraction of the yoghurt was similar to that of blueberry addition.

Results from compositional analysis reveal that experimental design was fulfilled and specific mass fractions of blueberry pulp and sugar were well controlled.

Table 1. Effect of blueberry and sugar mass fractions on the chemical properties of yoghurts

	w(blueberry)/%				*w*(sugar)/%
	0	12.5	25	37.5	
w(total solids)/%	15.03±0.13	14.81±0.02	14.97±0.01	14.82±0.04	0
	16.93±0.08	16.36±0.01	16.71±0.08	16.72±0.08	2
	18.68±0.12	17.92±0.02	18.56±0.11	18.36±0.01	4
	20.44±0.10	20.18±0.07	20.42±0.06	20.27±0.20	6
w(fat)/%	3.65±0.07	3.45±0.07	2.45±0.07	1.70±0.14	0
	3.50±0.14	3.05±0.07	2.35±0.07	1.75±0.07	2
	3.50±0.14	2.70±0.14	2.25±0.07	1.70±0.14	4
	3.50±0.14	2.75±0.07	2.30±0.14	1.85±0.07	6
w(protein)/%	4.92±0.20	4.23±0.01	3.77±0.02	3.22±0.01	0
	4.70±0.05	4.06±0.05	3.61±0.09	3.13±0.06	2
	4.64±0.08	4.05±0.01	3.60±0.11	3.08±0.08	4
	4.53±0.09	4.04±0.08	3.49±0.01	3.06±0.19	6
w(ash)/%	0.99±0.01	0.87±0.01	0.79±0.01	0.67±0.01	0
	0.96±0.01	0.85±0.02	0.79±0.01	0.66±0.01	2
	0.96±0.01	0.81±0.03	0.72±0.03	0.64±0.01	4
	0.93±0.02	0.78±0.01	0.73±0.01	0.64±0.01	6

Effect of storage time on pH

The effect of fruit and sugar level on the pH values of yoghurts during storage is shown in Fig. 1. The samples without fruit had the highest pH value, while the yoghurts with the addition of 37.5 % of fruit had the lowest value. This was caused by the low pH of the blueberry pulp (3.41) added to the yoghurts. The pH values of the samples with 12.5 and 25 % fruit were not significantly different (p>0.05). Increasing the mass fraction of sugar significantly reduced the pH values of the samples (p<0.05). This result was expected because the addition of a sugar source may help lactic acid bacteria to produce more acid. The pH values of the samples significantly declined throughout storage (p<0.05). The mean pH values of the yoghurts with fruit on the first and 20th day were 4.11 and 3.97, respectively. These values are similar to those found in cornelian cherry paste yoghurts (*16*) and lower than those found in mulberry pekmez (concentrated mulberry juice) yoghurts (*29*).

Effect of storage time on viscosity

The viscosity values of the yoghurts with added fruit were significantly different (p<0.05), but control yoghurts and those with added 12.5 % fruit were similar (p>0.05). The increase in the mass fraction of fruit significantly reduced the viscosity values of the yoghurts (Fig. 2). Samples without fruit had the highest viscosity, while the samples with 37.5 % fruit had the lowest. Viscosity values did not change as the sugar mass fraction increased (p>0.05). This may be due to lower amount of sugar (up to 6 %) used to balance the sweet taste in this study. During storage, viscosity values of the samples significantly declined (p<0.05). Parallel to our findings, Celik and Bakirci (*29*) stated that increasing mulberry pekmez ratio reduced the viscosity values of the yoghurts and they decreased throughout storage. Similar results were reported by Celik *et al.* (*16*).

The effect of fruit and sugar levels on the syneresis values of yoghurts during storage is shown in Fig. 3. Although the addition of fruit significantly increased the syneresis values of yoghurts compared to the control samples (p<0.05), the increase in the mass fraction of fruit (from 12.5 to 37.5 %) was not significant (p>0.05). Contrary to viscosity, the increase in the sugar mass fraction significantly increased the syneresis values of the yoghurts (p<0.05). However, the increase was not

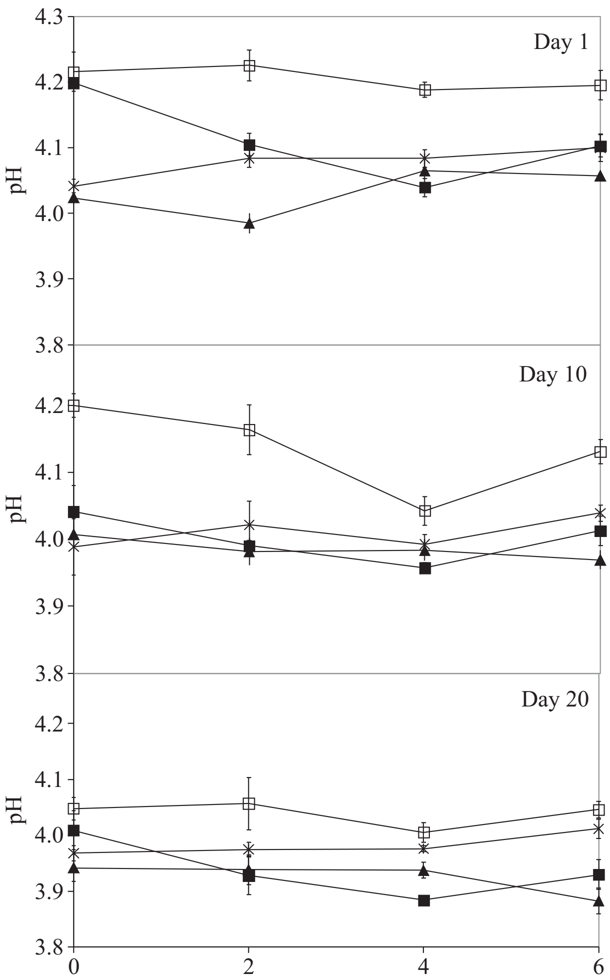

Fig. 1. Effect of blueberry and sugar mass fractions on the pH values of yoghurts during storage (□ yoghurts without blueberry; ■ yoghurts with 12.5 % blueberries; × yoghurts with 25 % blueberries; ▲ yoghurts with 37.5 % blueberries)

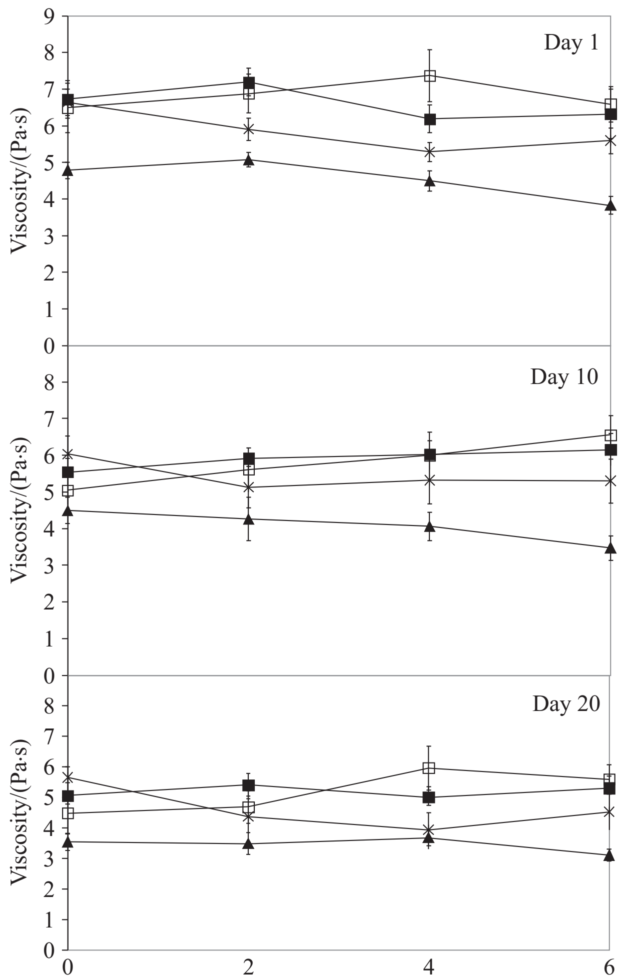

Fig. 2. Effect of blueberry and sugar mass fractions on the viscosity values of yoghurts during storage (□ yoghurts without blueberry; ■ yoghurts with 12.5 % blueberries; × yoghurts with 25 % blueberries; ▲ yoghurts with 37.5 % blueberries)

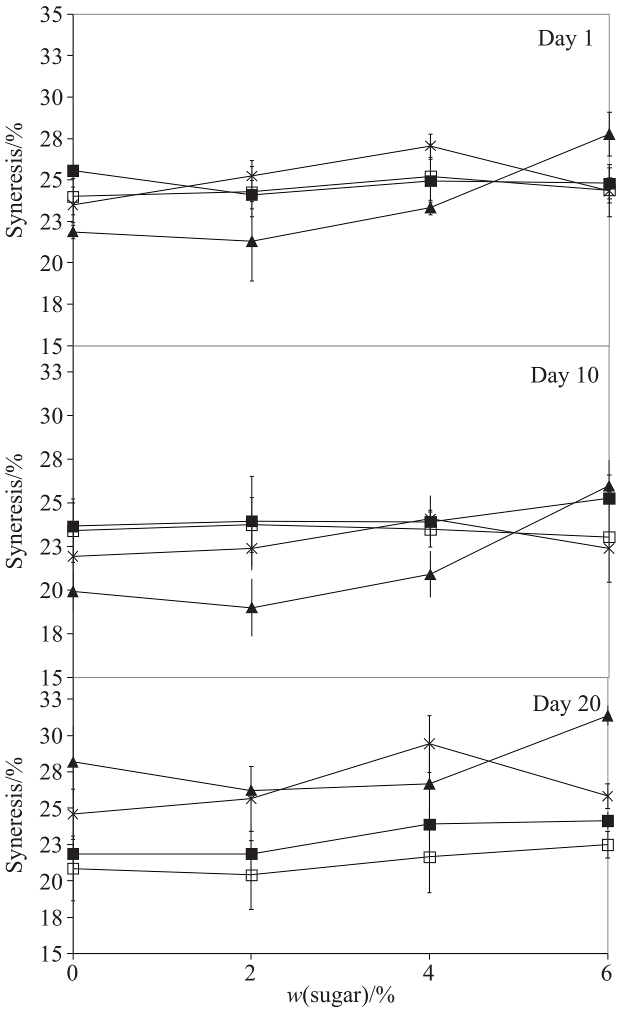

Fig. 3. Effect of blueberry and sugar mass fractions on the syneresis values of yoghurts during storage (□ yoghurts without blueberry; ■ yoghurts with 12.5 % blueberries; × yoghurts with 25 % blueberries; ▲ yoghurts with 37.5 % blueberries)

significant between 0 and 2 %, and 4 to 6 % levels. Since sucrose is a disaccharide, it is not able to bind free water to stabilize the gel as polysaccharides are. During storage, the mean syneresis values significantly decreased until the 10th day ($p<0.05$) and then increased more than the first day, but this was not statistically important ($p>0.05$). Celik *et al*. (*16*) observed a slow increase in syneresis values of cornelian cherry paste yoghurts between 14 and 21 days of storage.

Viscosity and syneresis results indicate that yoghurts with blueberries and sugar should be supplemented with an appropriate stabilizer to retain the physical quality of the product throughout storage.

Effect of storage time on colour

Whiteness (*L*), red/greenness (*a*), and yellow/blueness (*b*) values of the yoghurts are shown in Table 2. Colour values did not change significantly throughout storage; therefore, values after 10 and 20 days were not included in Table 2. As expected, whiteness values (*L*) of the blueberry yoghurts were significantly lower than of yoghurts without fruit. Blueberry addition at all levels significantly reduced the whiteness values of the yoghurts ($p<0.05$). The whiteness values (*L*) of the yoghurt samples with sugar were similar ($p>0.05$) but significantly lower than of the samples without sugar ($p<0.05$). The mean *L* value (47.7) of the yoghurts without fruit and sugar is closer to that found in strained yoghurts by Yazici and Akgun (*30*). Samples without fruit had a negative *a* (greenness) value. The addition of blueberries to the yoghurts contributed to the red colour of the samples. The highest *a* value was obtained in the samples with 25 % of fruit. Yazici and Akgun (*30*) found similar values in control strained yoghurts. The increase in the sugar amount did not affect the *a* values of any yoghurt ($p<0.05$). The average yellow/blueness (*b*) value of the samples without fruit was 8.37 as compared to 0.89 in 12.5 %, 1.70 in 25 %, and 3.22 in 37.5 % fruit levels. The increase in the sugar mass fraction significantly increased

Table 2. Effect of blueberry and sugar mass fractions on the colour (*L*, *a*, and *b*) values of yoghurts

	w(blueberry)/%				*w*(sugar)/%
	0	12.5	25	37.5	
L value	47.43±1.42	29.11±1.10	23.66±0.96	19.61±0.59	0
	46.42±1.27	28.61±1.18	22.74±1.13	19.28±0.52	2
	46.51±1.30	27.71±1.02	22.67±0.75	18.89±0.44	4
	46.53±1.32	27.69±0.80	22.33±0.74	18.45±0.68	6
a value	–2.91±0.07	7.59±0.30	9.28±0.40	8.61±0.40	0
	–2.85±0.11	7.74±0.32	9.33±0.35	8.64±0.42	2
	–2.86±0.14	8.25±0.43	9.03±0.39	8.35±0.29	4
	–2.96±0.07	8.00±0.32	8.89±0.46	8.34±0.30	6
b value	8.39±0.10	0.51±0.26	1.71±0.42	3.22±0.40	0
	8.30±0.16	1.03±0.27	1.65±0.26	3.22±0.39	2
	8.38±0.22	1.11±0.27	1.64±0.27	3.33±0.27	4
	8.44±0.11	0.92±0.30	1.78±0.34	3.12±0.34	6

the yellow colour values of the samples compared to control yoghurts ($p<0.05$). The average *b* values of the yoghurts without fruit are similar to those found in control strained yoghurts (*30*).

Effect of storage time on sensory properties

The sensory evaluation values of the yoghurts with added blueberries are shown in Table 3. The average flavour scores show that samples with 12.5 % fruit took the lowest scores compared to 25 and 37.5 % fruit added to yoghurts, indicating that the increase in the mass fraction of blueberries had a positive effect ($p<0.05$). Although samples without fruit and sugar had the highest scores, the addition of sugar to these samples significantly decreased the flavour scores. Increasing sugar mass fraction in the samples with blueberries significantly increased the scores ($p<0.05$). The highest flavour scores were obtained in the samples with 4 % sugar added; however, the mean flavour values of samples with added sugar were not statistically significant ($p>0.05$). Storage time had a negative impact on flavour

Table 3. Effect of blueberry and sugar mass fractions on the sensory properties of yoghurts during storage

	t(storage)/day	*w*(blueberry)/%				*w*(sugar)/%
		0	12.5	25	37.5	
Flavour	1	9.00±0.77	6.13±0.07	6.95±0.18	6.85±0.34	0
	10	8.55±0.07	6.50±0.14	6.23±0.05	6.33±0.38	
	20	7.80±1.47	6.60±1.47	6.15±1.42	6.43±1.58	
	1	8.32±0.58	7.20±0.92	7.56±0.41	7.70±0.21	2
	10	8.10±0.42	6.68±0.26	7.02±0.12	7.53±0.38	
	20	8.10±1.33	6.60±1.35	7.10±1.45	7.10±1.68	
	1	7.60±0.31	7.20±0.80	7.82±0.13	7.56±0.24	4
	10	7.40±0.28	6.75±0.35	7.75±0.21	7.78±0.12	
	20	8.20±1.06	6.55±1.73	7.35±1.42	7.45±1.50	
	1	7.23±0.44	7.36±0.51	7.58±0.05	7.48±0.30	6
	10	7.08±0.12	7.18±0.16	7.50±0.14	7.47±0.09	
	20	7.35±1.53	6.60±1.76	7.25±1.41	8.20±1.64	
Texture	1	4.61±0.16	4.12±0.10	3.94±0.24	3.80±0.42	0
	10	4.60±0.28	4.42±0.26	4.29±0.08	3.81±0.06	
	20	4.55±0.69	4.10±0.72	4.00±0.79	3.60±0.75	
	1	4.55±0.06	4.18±0.07	3.95±0.20	3.67±0.46	2
	10	4.53±0.38	4.33±0.38	4.16±0.27	3.84±0.01	
	20	4.70±0.47	4.25±0.72	4.05±0.69	3.75±0.85	
	1	4.61±0.22	4.23±0.06	3.90±0.46	3.59±0.51	4
	10	4.57±0.19	4.27±0.33	3.99±0.22	3.74±0.15	
	20	4.65±0.67	4.00±0.86	4.00±0.86	3.60±0.75	
	1	4.34±0.04	3.83±0.14	4.10±0.31	3.52±0.03	6
	10	4.58±0.16	4.27±0.61	4.26±0.27	3.63±0.46	
	20	4.45±0.60	3.95±1.00	4.05±0.89	3.85±1.73	
Appearance and colour	1	4.70±0.09	3.90±0.31	4.40±0.37	4.27±0.27	0
	10	4.35±0.35	3.55±0.35	4.22±0.02	4.32±0.40	
	20	4.65±0.81	3.95±0.94	4.35±0.75	4.15±0.93	
	1	4.73±0.06	3.92±0.33	4.37±0.46	4.18±0.26	2
	10	4.67±0.05	3.68±0.16	4.30±0.28	4.18±0.31	
	20	4.70±0.73	3.85±0.99	4.20±0.89	4.15±1.04	
	1	4.64±0.13	4.15±0.28	4.37±0.46	4.10±0.37	4
	10	4.67±0.05	3.72±0.12	4.33±0.24	3.92±0.26	
	20	4.75±0.44	3.90±0.97	4.30±0.92	4.10±1.07	
	1	4.53±0.17	4.09±0.31	4.43±0.10	3.97±0.07	6
	10	4.50±0.14	3.73±0.38	4.37±0.05	3.85±0.35	
	20	4.70±0.47	3.85±1.04	4.35±0.93	4.10±0.97	

scores and the first day scores were significantly higher than on the 7th and 20th day (p<0.05). The most noted defect by the panelists was high acidity for all samples at the end of the storage period. Approx. 50 % of the panelists indicated a higher acid flavour of the samples without sugar and with 2 % sugar. Too much fruit flavour was perceived by almost 25 % of the panelists for the samples with 37.5 % fruit. Thirty percent of the panelists criticized the samples with 6 % sugar for being too sweet. All yoghurt samples without fruit received significantly higher body and texture scores than yoghurts with fruit throughout storage (p<0.05). Samples with 37.5 % fruit received the lowest score among the samples with added fruit, while the mean scores of the yoghurts with added 12.5 and 25 % fruit were not statistically different (p>0.05). Sugar mass fraction did not significantly change the body and texture scores of the samples during storage (p>0.05). Especially samples with 37.5 % fruit were criticized for being too weak (approx. 50 %) at the end of the storage period. The addition of fruit at all levels significantly affected the appearance and colour scores of the samples (p<0.05). Among the samples with added fruit, the highest score was obtained for the samples with 25 % fruit, while the lowest was obtained for the samples with 12.5 % fruit. Panelists found that the yoghurts with 12.5 % blueberries lacked optimum blueberry colour and the yoghurts with 37.5 % blueberries had too intense blueberry colour. Twenty percent of the panelists observed some syneresis in the yoghurts with 37.5 % fruit. The same pattern in the body and texture scores was also observed in the appearance and colour scores as the sugar amount and storage time increased.

Conclusions

Incorporation of blueberries to yoghurt formula was successfully achieved. Blueberry addition significantly decreased pH, fat, protein, ash, viscosity, and *L* values; increased syneresis and *a* values; and did not change the mass fraction of total solids in the yoghurts. Sugar addition increased total solids, *b* and syneresis values; decreased pH, fat, ash, and *L* values; and did not change protein, *a* and viscosity values. Panelists gave the highest flavour, body and texture, and appearance and colour scores to the yoghurts with 25 % of blueberries among the yoghurts with added fruit. Sugar addition improved flavour scores, but did not affect the body and texture, or appearance and colour scores of the samples. In general, storage time had a negative effect on physicochemical and sensory properties. From this study, it can be concluded that blueberries can be added to the yoghurt formula at 25 % level in combination with 4 % of sugar.

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